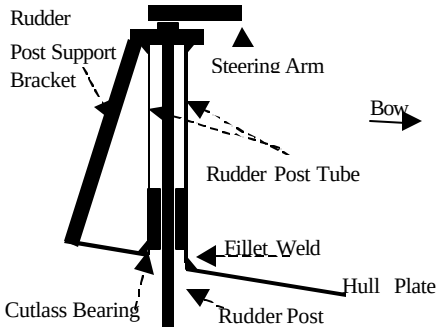
U.S. Coast Guard
Marine Safety Office, Portland, Maine

SAFETY ALERT 01-01

Repairs to Steering Gear, Thru-Hull Fittings, & Machinery

The year 2000 saw several Maine fishermen die and even more fishing vessels sink, due in part to improper repairs to steering gear, thru-hull fittings, and machinery. In one case, the Coast Guard concluded that flooding began through a failed rudderpost fitting. The rudderpost fitting (see Fig 1) was typical of Gulf of Mexico shrimp fleet vessels built in the early 1960's.

Figure 1, Rudder Port Fitting Before Repair



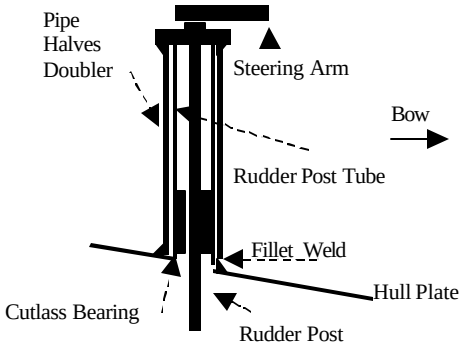
The rudderpost tube was wasted, and the owner conscientiously chose to repair it. Rather than replacing the tube, which would have required drydocking and dropping the rudder, they instead doubled the tube with a piece of pipe sliced and re-welded together around the old tube. In order to fit the pipe halves around the tube, a fillet weld at the base of the old tube was ground off, and channel brackets supporting the fitting were removed. The new pipe halves did not fit snugly around the old tube. Keeping in mind the cutlass bearing inside the old tube, the welds that were ground away were critical to support the rudderpost. Also, when the repair was completed, only two of the three rudderpost support brackets were re-installed. Finally, a new hydraulic control system was added to provide more power to the steering control system, which greatly added load on the rudder port fitting.

This repair likely weakened the overall fitting. Though it may seem intuitive that adding metal to a structure would add strength, this is only true when stresses remain balanced. In this case, stresses were redistributed, concentrated, and therefore, multiplied at critical points in the fittings.

Factors that may have weakened the fitting

After grinding the weld where the old tube connected to the hull, the cutlass bearing was no longer well supported and the weld probably cracked. The gap between the pipe halves and the old tube was relatively small, creating weld discontinuities as the pipe halves were welded together. This small gap allowed the new tube to be intermittently welded to the old tube with intermittent burn-throughs at thin areas of the old tube. Most likely, both of these defects occurred randomly as the weld was laid down and the old and new rudder tubes were unintentionally welded together. This created a lever, multiplying the stress at the weld where the pipe halves were jointed to the hull. The welding process adds a great deal of heat to a small area, which without stress relief traps the stresses. Cracks commonly result from these conditions, as all the stresses are concentrated at the weld discontinuities.

Figure 2, Rudder Port Fitting After Repair



Not reattaching the fore and aft rudderpost support bracket also weakened the overall structure. Additionally, the load on the fitting was increased substantially by the new hydraulic package. The combination of a weaker structure, and a more powerful control system, would have easily in time, overworked the rudder post fitting, breaking it free from the hull and producing a hole as large as six square inches.

In the other case, an improperly packed rudderpost fitting allowed flooding to go unnoticed until the rear deck of the vessel was awash and water poured in through a non-watertight lazarette hatch. The vessel quickly sank by the stern, allowing very little time for the crew to prepare for abandonment.

These tragedies indicate the need to properly assess the condition of all vital assemblies on a vessel. If a repair cannot be made in kind, a qualified engineer should be consulted to determine if the modifications will properly distribute and withstand stresses. Proper welding procedure and stress relief are essential to minimizing trapped-in stresses. Before adding powered controls to any system, the structure of that system must be evaluated and augmented to withstand the new loads, and must also be considered whenever any modifications are contemplated for other heavily loaded systems, including fishing gear, engine beds, stuffing boxes, machinery mounts, shaft bearings, etc. When in doubt, consult an engineer or a Coast Guard Commercial Fishing Vessel Examiner.

For more information please contact:
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